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Signed Andrew Gerrey

Dated - 4 OCT 2000

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference — M99/0466/GB

2. Patent application number *(The Patent Office will fill in this part)* — **9920876.1** — 4 SEP 1999

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Aim Design Limited
26 Kings Drive
Heaton Moor
Stockport
Cheshire
SK4 4DZ

Patents ADP number *(if you know it)* 7733959001

If the applicant is a corporate body, give the country/state of its incorporation — Great Britain

4. Title of the invention

METHODS AND APPARATUS FOR CLEANING PIPES

5. Name of your agent *(if you have one)*

McNeight & Lawrence

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Regent House
Heaton Lane
Stockport
Cheshire SK4 1BS

Patents ADP number *(if you know it)* 0001115001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

METHODS AND APPARATUS FOR CLEARING PIPES

This invention relates to methods and apparatus for clearing pipes.

Pipes, such as water pipes, pipes in industrial plants for transferring liquids, slurries, particulate materials, as well as air ducts, oil pipelines, drains and so forth, are conventionally cleared of the flowable material conveyed in them or of accumulated sediment by means of a pig, a device sent through the pipe, either by hauling or pushing or under its own power.

In straight, circular section pipes, pigs are usually quite satisfactory, but problems arise with non-circular sections or pipes which have changes in direction or bifurcations.

The present invention provides methods and apparatus for clearing pipes which represent substantial improvements over pig-associated methods and apparatus.

The invention comprises a method for clearing pipes having an inlet end and one or more outlets, comprising

- at said inlet end, forcing a gas into the pipe with said outlet or at least one of said outlets open to discharge pipe contents forced through by said gas, using gas forcing means capable of maintaining an overpressure sufficient therefor at a low flow velocity;

- when said pipe contents have been discharged, again at said inlet end, and with said outlet or at least one of said outlets open, forcing a gas into the pipe at a lower overpressure and a higher flow

to be cleared. Given this "ball park" figure of 20 m/s, trial and error will readily establish the gas forcing requirements for any given pipe system.

Likewise, the amount of overpressure required for an adiabatic heating drying step can be readily calculated from Boyle's Law, and the gas forcing requirements adjusted to achieve that, if not already adequate from pipe clearing considerations, while the throttling can be adjusted to bring about the required pressure increase while ensuring a sufficient flow through of the gas to eliminate the evaporated cleaning fluid.

The invention also comprises apparatus for clearing pipes, comprising

- gas forcing means connecting to an inlet end of the pipe;
- valve means adapted to throttle down an outlet of the pipe;
- said gas forcing means and valve means being adapted to the pipe to cooperate to effect both higher pressure, low flow velocity and lower pressure, high flow velocity of gas through the pipe.

The gas forcing means may comprise a pump.

The gas forcing means may however comprise blower, turbine or compressor means, which may be capable of generating a gas flow velocity through the pipe of the order of 20 m/s.

The forcing means and valve means may be adapted to the pipe to cooperate to elevate the pressure inside the pipe so as to increase the temperature of the gas in the

differing cross-section along their length, rodding and jetting systems can be problematical at best, and potentially capable of damaging a pipe, or adding to damage already present.

Apparatus according to the invention can be trailer-mounted for servicing drains - of course, building drains will not usually require anything beyond the clearing steps, and so fitting a throttled outlet will not usually be required.

Embodiments of apparatus and methods for clearing pipes according to the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic illustration of a basic system according to the invention;

Figure 2 is a diagrammatic illustration of an installation in a typical manufacturing plant;

Figure 3 is an elevation of a typical blower end of an apparatus;

Figure 4 is an elevation of an outlet end for the apparatus of Figure 3 arranged for pipe clearing; and

Figure 5 is an elevation of the outlet end of Figure 4, arranged for liquid cleaning and drying.

The drawings illustrate methods and apparatus for clearing pipe 11 having an inlet end 11a and one or more outlet ends 11b. In the diagrammatic apparatus of

The method is of general applicability, regardless of the length of the pipe - pipelines up to several kilometres in length could be cleared in this way - and regardless, also, of the cross-sectional size or shape of the pipe. Thus the method may be used to clear process pipework in industrial plants, hot air and air conditioning ducting, drains and sewers, even if the pipe is damaged or changes in cross-section (whether shape or size) or direction (even if there are right-angle bends), and even if there are sharp steps in the pipe and internal obstructions such as instrument probes, flanges, or tree roots in drains and sewers.

The high pressure, low velocity step will usually clear away the bulk of material in the pipe, leaving, however, material that may lie in U-formations or be trapped against protuberances - it will, at least, clear a gas flow path through the pipe.

The low pressure, high velocity step will clear out any such detritus left behind after the high pressure step. The lifting power of a fluid flow can be proportional to the fourth power of its velocity - even a small increase in velocity above a nominal 20 m/s can result in a substantially greater ability to pick up and carry out liquids, solids or mixtures thereof left in the pipe after the high pressure, low velocity step.

The cleaning fluid - which will usually be water, but which may be any other liquid appropriate to the cleaning task in hand, for example an organic solvent - may flow through the pipe and be cleared from the pipe if necessary by re-use of the high pressure, low velocity and low pressure, high velocity gas blowing steps.

Any film of cleaning fluid left on the walls of the pipe and, of course, any pools of fluid left behind by the blowing operations, will be evaporated by adiabatic heating as the pipe outlet is throttled down, leading to a pressure increase while permitting flow through the pipe to carry away the evaporated cleaning fluid.

pressure inside pipe 22 increases to heat the gas adiabatically and evaporate the cleaning liquid, which is expelled from the valve 29d as vapour carried in the gas outflow.

The process is repeated for pipe 26.

An important advantage over prior art methods of process pipe cleaning is that product is not lost to waste, but can be delivered to a stock tank - no foreign body is inserted into the pipe that might spoil or contaminate the pipe contents.

Figure 2 shows cleaning liquid connectible *via* valves 29c and 29f to pipes 22 and 26 in turn.

The entire arrangement can be made as a retrofit to existing plant, or designed into new plant.

Figures 3, 4 and 5 are elevations showing how one arrangement would appear in practice.

Figure 3 illustrates the blower unit 29, which comprises a motor 41, driving a fan 42. A valve tree 43 includes a filter 44 so that the blower unit 29 delivers filtered air to the pipe 22. Valve 29a is shown, without connection from the mixing tank 21, connecting to the pipe 22, Figure 2.

Figure 4 shows a possible arrangement at the outlet end, or an outlet end of a system such as is illustrated in Figure 2, in which the pipe 22 terminates in a riser 22a with an attached section 22b delivering into a receiving tank 51. Figure 5 shows the same riser 22a to the pipe 22 adapted for the adiabatic temperature increase by the section 22b being removed and substituted by a valve arrangement 52 which can be

pasteurisation, is required, a heating blower can be used or - and especially where large pipes or systems are concerned, even a gas turbine.

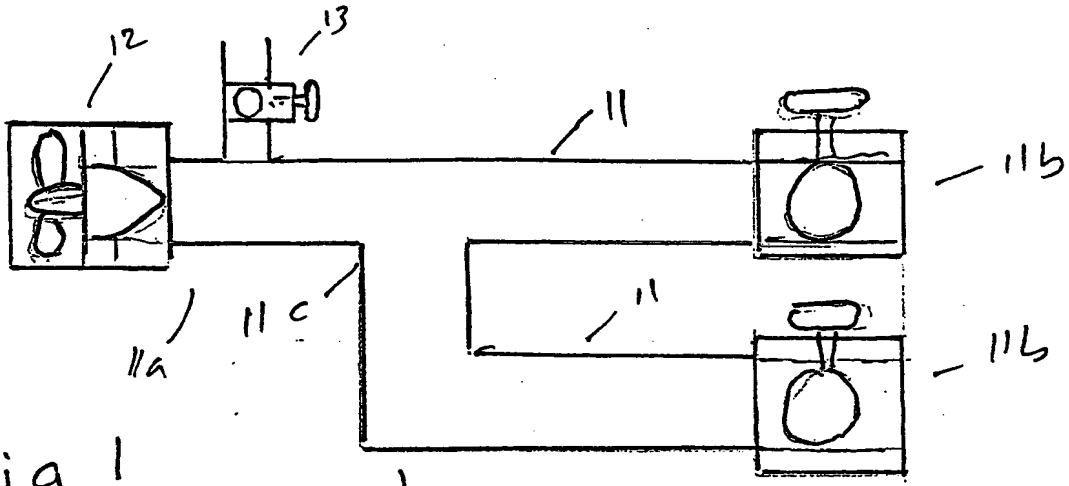

Fig 1

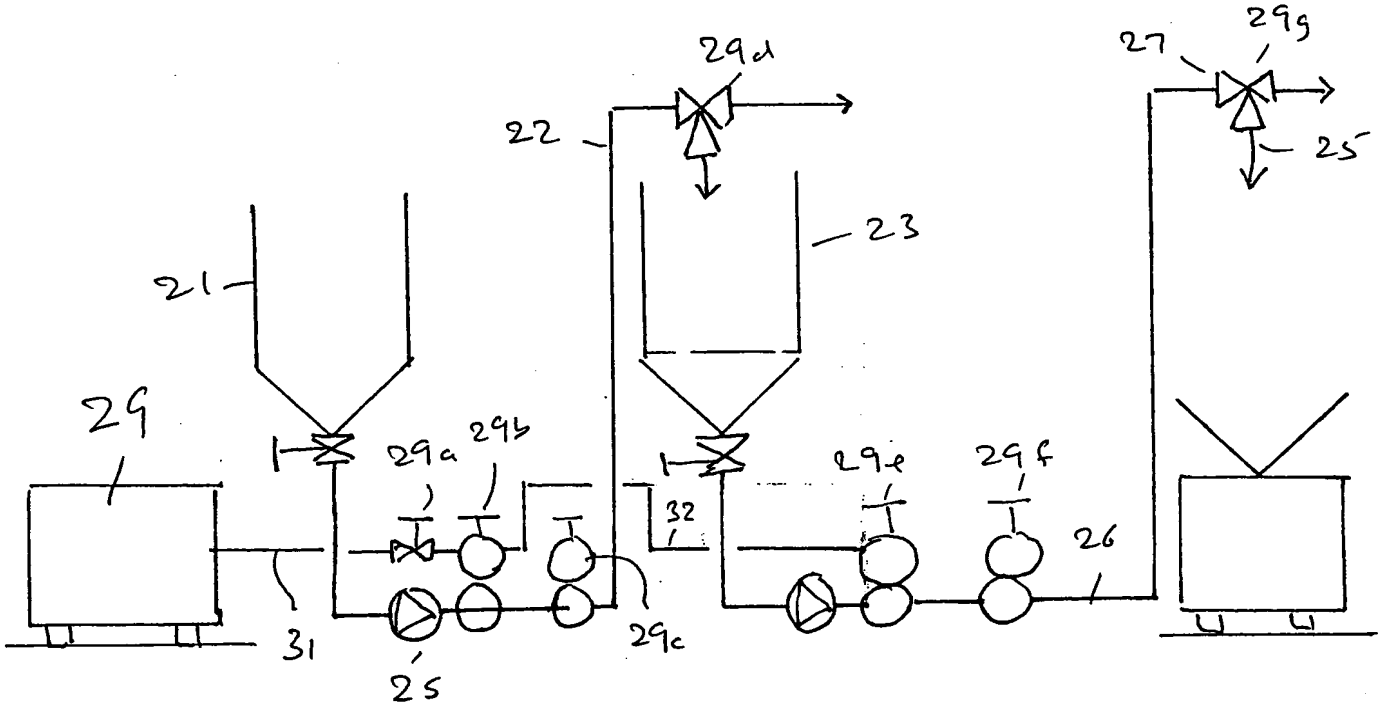

FIG 2

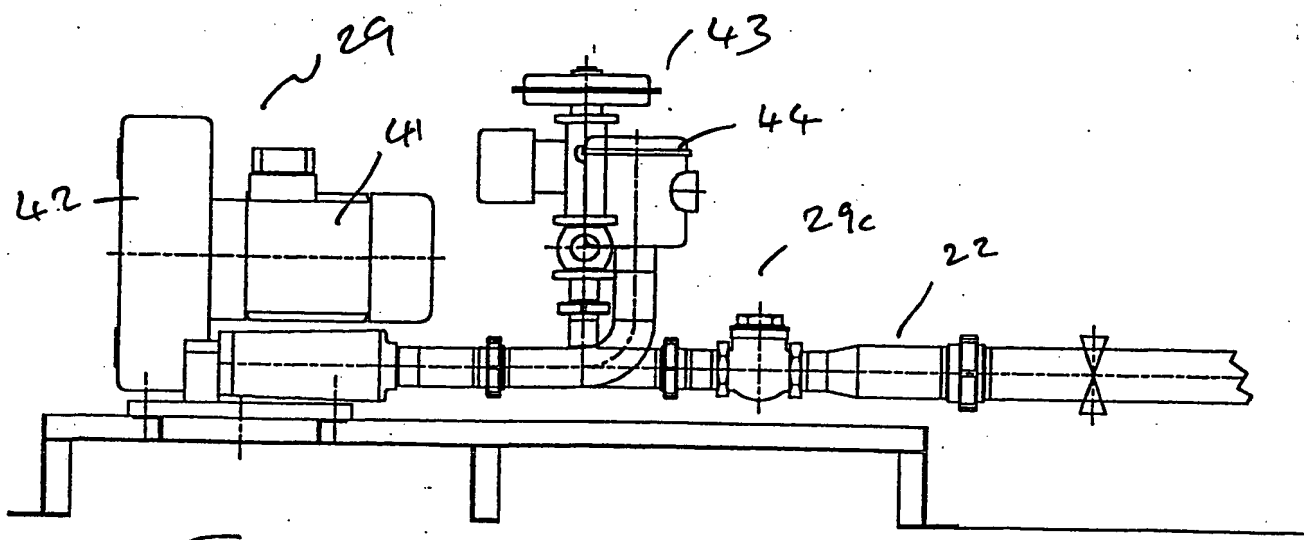

Fig 3

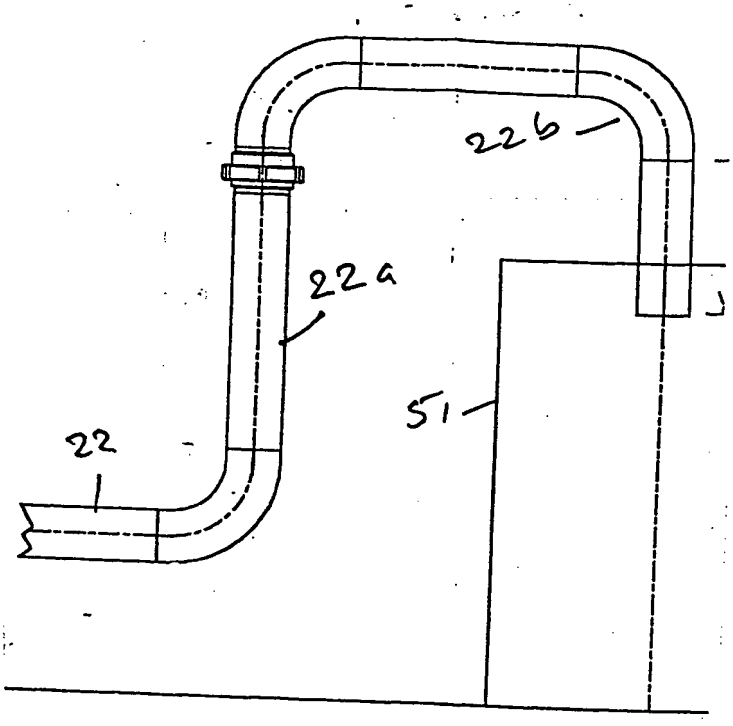

Fig 4

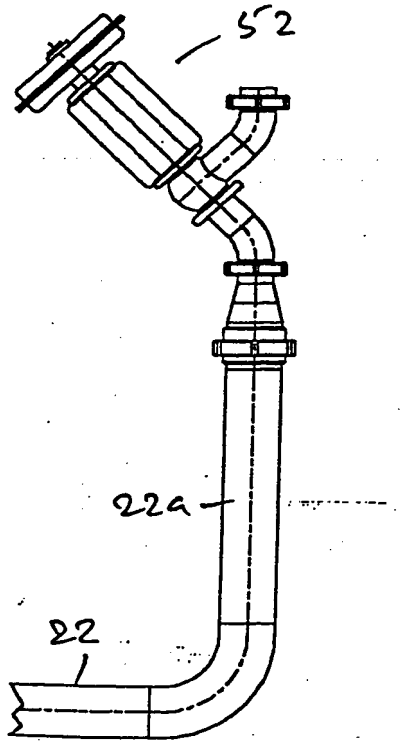

Fig 5